File under GUTERMAN

'Diseases of Iris'

Bulletin 324 July 1935

THE BEARDED IRIS

A. M. S. PRIDHAM, C. E. F. GUTERMAN,
GRACE H. GRISWOLD, and L. F. RANDOLPH

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THE BEARDED IRIS

A. M. S. PRIDHAM

THE BEARDED iris is preeminently a garden flower and has few rivals in wealth of color. Seldom do plants offer such remarkable examples of fine proportion, form, and texture. It is the appreciation of these characteristics that makes the iris enthusiast a keen observer and explains his never-ending experiments in the location and composition of his iris groups with relation to sun and shadow, to neighboring plants, and to background.

With few exceptions bearded irises are perfectly hardy and easily cultivated. One or two important rules must, however, be followed. Irises demand a well-drained soil and must have plenty of sunlight. The plants will thrive in relatively poor soil and can stand surprising periods of drought. They will flourish in rich, well-prepared soils, light or heavy, and will benefit by abundant watering just before the flowering period.

IRIS IN THE GARDEN

THE IRIS is particularly valuable in the garden. The innumerable gradations and combinations of the light tones of yellow, lavender, white, and pink can be used effectively for massing, especially where the

FIGURE 1. THE BEARDED IRIS DEMANDS A WELL-DRAINED SOIL AND PLENTY OF SUNLIGHT

sunlight will play on them and against a dark background of foliage. The deeper tones of purple and red-purple are excellent for accent, while the wide selection of blends, bicolor, and plicata types make interesting specimen plants whose value is enhanced by the gracefullness of the stems and by the shape of the flowers themselves.

The actual placing of the plants in the garden becomes as intricate a matter as the arrangement of cut flowers or as the painting of a picture. It is well to study the location of each group from the various rooms in the house, from the porch, and from a garden seat.

To devote the whole garden to iris is a mistake, for after the flowers have gone one soon tires of the foliage. If the garden is large, an appropriate background will make large groups of irises not only possible but desirable. In the small garden, a few light groups of irises will fit effectively into the garden picture.

Background is important and deserves careful consideration. Background limits the view, usually at the eye level, and one's attention is focused on the immediate foreground. The garden picture itself must, by its variety of interest, hold one's immediate attention. The fact that the background is almost immediately behind the flowers demands even further thought in the location of the individual groups of flowers. This applies especially to the effects of sunlight and shadow and to the height, form, and texture of the plants themselves.

FIGURE 2. THE IRIS BELONGS IN GROUPS, NOT NECESSARILY LARGE ONES, BUT IN GROUPS OF A SINGLE COLOR

These groups are thoughtfully placed with reference to background and to neighboring plants

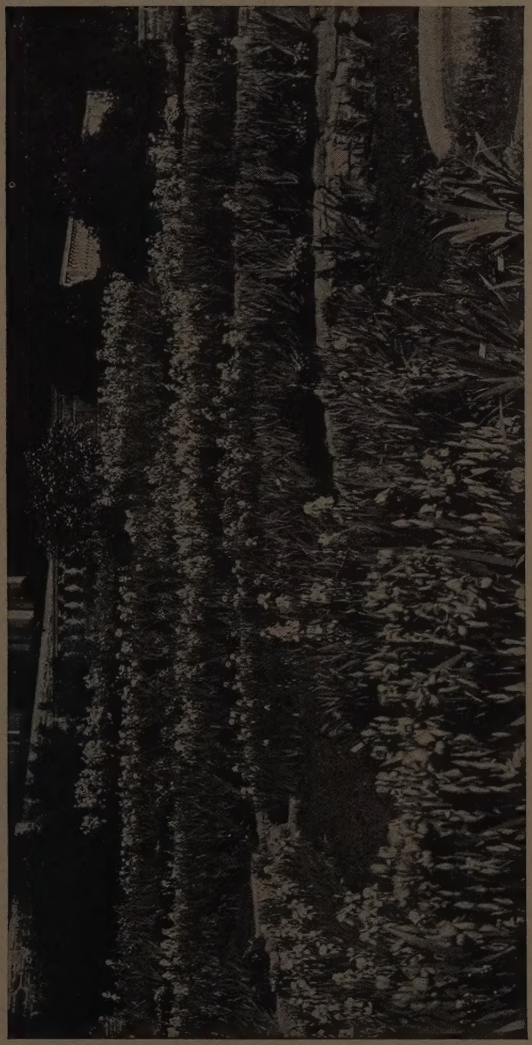


FIGURE 3. THE BEARDED IRIS CAN BE USED TO ADVANTAGE IN THE FORMAL GARDEN WHERE IT TIES IN WITH ARCHITECTURAL FEATURES

Evenness of texture and of color is desirable regardless of the plant material used as a background. A row of mixed shrubbery is seldom satisfactory, though a single shrub in full bloom with suitable irises in the foreground may create a picture. With a broad foreground of grass, a group of irises against Spirea van Houttei, Rosa Hugonis, the light green of *Carageana arborescens*, or the purple foliage of the beech, and a suggestion of trees beyond makes a splendid picture.

Occasionally irises are silhouetted against the sky by planting them on the top of a terrace. They are more successfully silhouetted against distant trees or an expanse of green lawn. If used against a drab stone wall or a rockery, large masses of light colors will prove ineffective, for the delicate tones shade in with the dark shadows of the crevices. Even when masses are used the beds should be narrow; an 8-foot bed is ideal for delphinium but a 4-foot one is more suitable for iris.

The list of annual and perennial plants with which iris can be successfully used is a long one, and the individual selection must be largely a matter of personal taste. Low-growing plants, such as violas, petunias, annual phlox, and others of compact growth should not be used among the iris clumps. These plants spread rapidly, shading the rhizomes and keeping them moist so that disease finds an easy foothold. Plants like the peony, which do not carry their foliage down to the ground level and which flower well above the iris, are ideal. Tulips and other bulbous plants are frequently recommended and are often very effective companion plants.

VARIETIES OF BEARDED IRIS

IT IS NOT the purpose at this time to present detailed descriptions of a long list of varieties. New ones are offered by the hundred each year and are rated by the American Iris Society. The results of this work are published in the bulletin of that society so that the enthusiast may keep up to date by following these reports.

To select a brief list of reliable varieties which will do justice to the vast wealth of material available is not an easy task. In many respects the new varieties are superior to the older ones, but in a recent questionnaire the variety which received the greatest number of votes as a dependable variety was Princess Beatrice which has been grown for more than three hundred years. In fact, many of the dependable varieties have truly come of age, being introduced prior to 1914.

The list (table 1), on pages 11 to 14 is intended to give the names of varieties which are acknowledged to be good and whose price is within the range of most gardeners. An effort has been made to include representatives of the colors and types available.

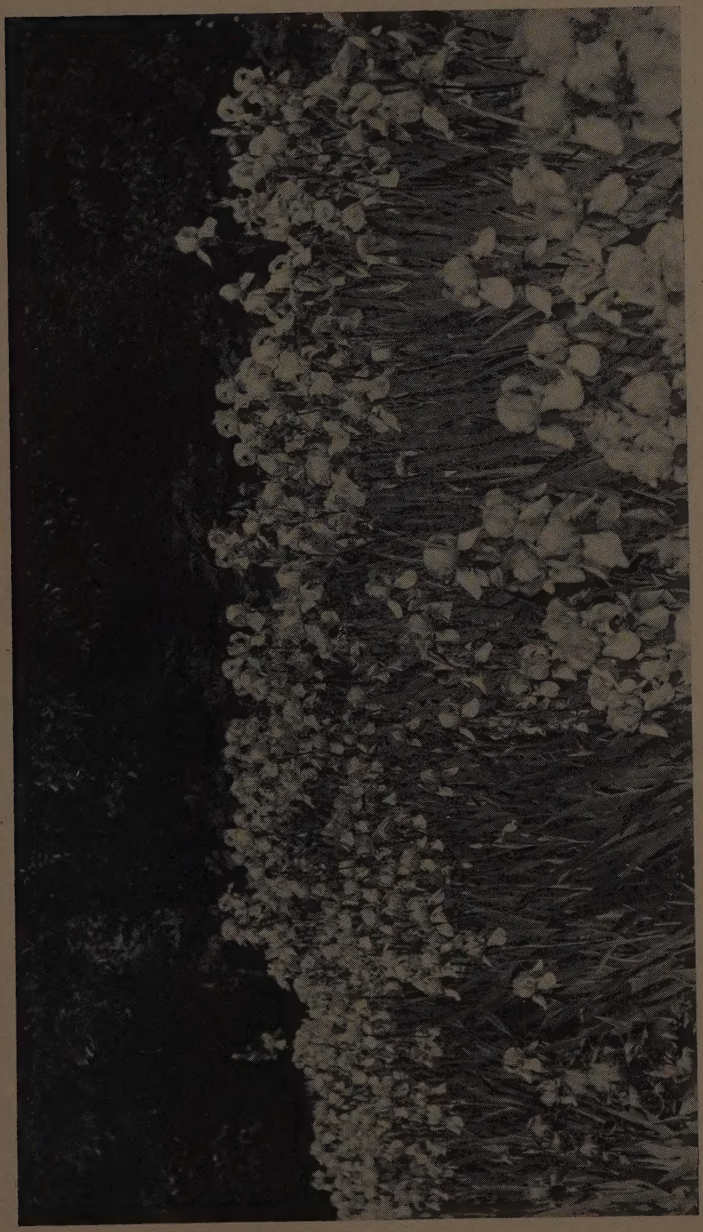


FIGURE 4. A GARDEN MASS OF TALL BEARDED IRISES WELL FRAMED BY FRUIT-TREE FOLIAGE

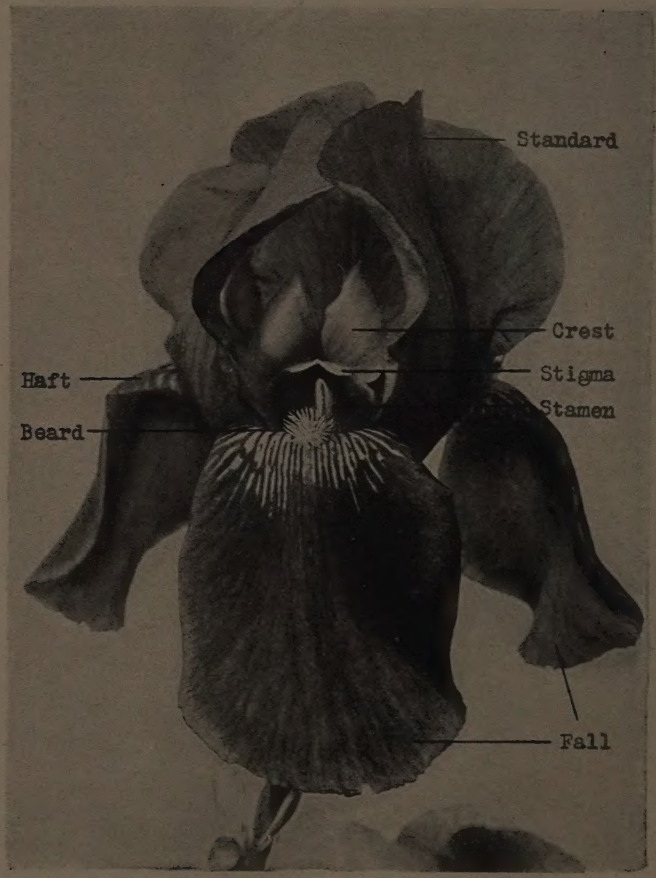


FIGURE 5. STRUCTURE OF THE IRIS FLOWER
(From Shull, "Rainbow Fragments," Doubleday, Doran Outdoor Books)

In a general classification of iris varieties the following color groups are used: white, yellow, blue, red, and pink. Varieties are also classified on the color relations of the standards and the falls. When both the standards and the falls are of the same color, the term *self* is used. When the standards are of one color and the falls are of a different but related color the term *blend* is used. If the standards are of one color and the falls of a different and contrasting color, the term *bicolor* is used. When the falls in a bicolor are distinctly veined rather than of one solid color, either the

FIGURE 6. DIFFERENT TYPES OF FLOWERING STALKS

a, One-flowered head (pumila); *b*, two-flowered head (typical of the Onco-pogon); *c*, low-branched to ground, spathes conspicuous (*aphylla*); *d*, few, short-branched, above center, erect (*germanica*); *e*, more widely branched (*pallida* x *variegata*); *f*, high, short, close-branched, stiff stem (*pallida*); *g*, short, low-branching, below center, erect (*variegata*); *h*, well and widely branched (E. H. Jenkins, *trojana* hybrid); *i*, fastigiate-branching (*cypriana, mesopotamica*); *j*, flexuous, well-branched, high (*cypiana, pallida* hybrid); *k*, flat head, curious branching, giving mass effect (*cypiana, variegata* hybrid); *l*, angular stem and branching (*trojana*)

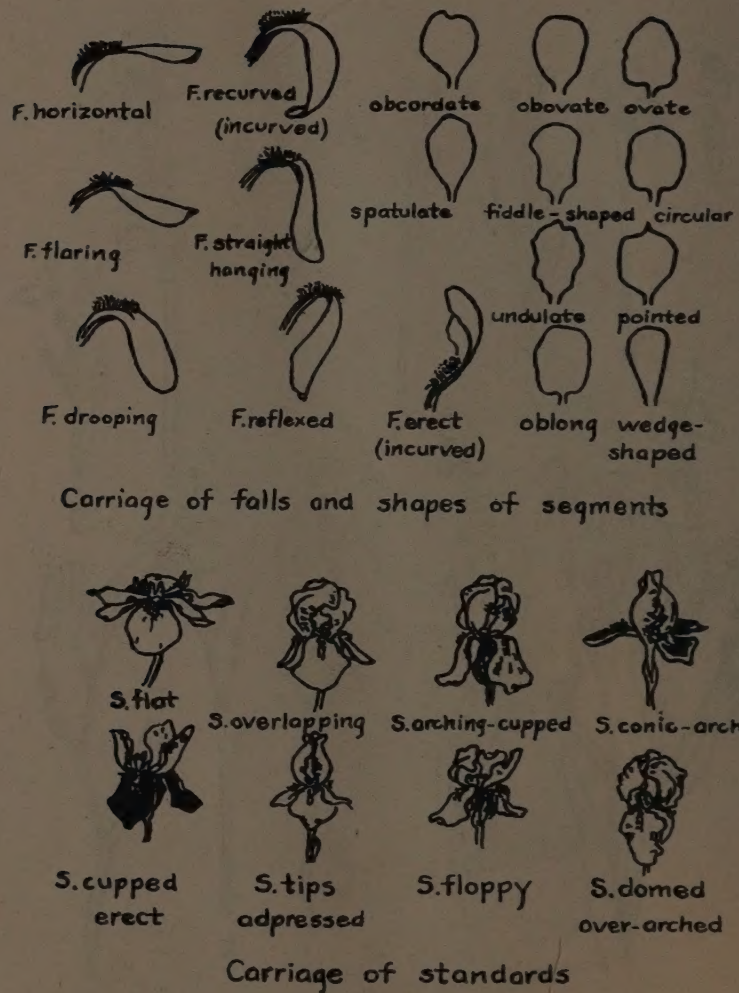


FIGURE 7. CARRIAGE AND SHAPE OF SEGMENTS

term *veined bicolor* or *variegata* is applied. When the standards are marked, the term *plicata* is used. The color classification chart, published by F. X. Schreiner in 1926, has been adopted by the American Iris Society and was followed in their *Alphabetical Iris Check List* published in 1929.

In the table, the name of the variety, the originator, and the date of

introduction are given. Color is described in terms of the main color as followed in the general classification (white, yellow, blue, red, and pink). The color relation of the standards and the falls (figure 5) is given under the abbreviations: *S.*, self; *Bi.*, bicolor; *Bl.*, blend; *Pl.*, plicata. Reference is also made to the depth of the main color which is abbreviated as follows: *L.*, light; *M.*, medium; *D.*, deep. Modifying or secondary colors to the main one are listed. These include the color of the standards in bicolor types and that of the markings in veined bicolors and in plicatas. Height of the plant is given under the abbreviations: *T.*, tall (36 inches and over); *M.*, medium (24 to 36 inches); *S.*, short or dwarf (24 inches or less). The season of bloom is classified under the abbreviations *E.*, early; *M.*, midseason; *L.*, late; as well as such combinations as *E. M.*, early midseason and so forth.

TABLE 1. VARIETIES OF TALL BEARDED IRISES

Variety name	Originator	Color				Height	Season
		Main	Type	Depth	Secondary		
Afterglow	Sturtevant	Yellow	Bl.	L.	Pink-lavender	T.	M.
Alameda	Mohr, Mitchell	White	Pl.	..	Light blue-violet	T.	M.
*Alcazar	Vilmorin	Blue	Bi.	D.	Purple	T.	E.
Alcina	Connell	Yellow	Bl.	M.	Cream-yellow	T.	M.
Aliquippa	Hall	Yellow	S.	L.		M.	M.
Alliés	Vilmorin	Red	Bi.	D.	Violet-copper	M.	M.
*Allure	Murrell	Yellow	Bl.	L.	Pink	T.	L.
*Ambassadeur	Vilmorin	Red	Bi.	D.	Bronze, lavender-crimson	T.	M.
Amber	Dykes	Yellow	S.	L.		M.	M.
*Ambrosia	Sturtevant	Pink	S.	L.	Light pink	T.	M.
Andante	Williamson	Blue	Bi.	M.	Deep red-purple	T.	M.
Ann Page	A. Hort	Blue	Bi.	M.	Lavender	T.	M.
Apache	Farr	Red	Bi.	D.	Coppery red	S.	M.
*Aphrodite	Dykes	Pink	S.	M.		T.	L. M.
*Asia	Yeld	Blue	Bi.	L.	Lavender, yellow	T.	M.
Autumn King	H. P. Sass	Blue	Bi.	M.	Blue-purple	M.	M.
Avatar	Williamson	Yellow	Bl.	M. D.	Grey-violet	M.	T.
Balboa	Mohr	Blue	Bi.	M.	Blue-purple	T.	M.
Baldwin	H. P. Sass	Blue	S.	M. D.	Manganese-violet	M.	M.
*Ballerine	Vilmorin	Blue	Bi.	L.	Two tone blue	T.	M.
*Beau Sabreur	Williamson	Yellow	Bi.	M.	Bronze, red	M.	M.
Benbow	Bliss	Blue	S.	M.		M.	M.
Blue and Gold	Essig	Blue	S.	M.		T.	M. E.
Blue Banner	Kirkland	Blue	Bi.	M.	Two-tone blue	M.	M.
*Blue Velvet	Loomis	Blue	S.	D.		T.	M.
Bluet	Sturtevant	Blue	S.	L.		M.	E.
Broadicea	Nicholls	Yellow	Bl.	L.	Pink-buff	T.	M.
*Bruno	Bliss	Red	Bi.	D.	Olive-purple	T.	M.
Buto	H. P. Sass	Blue	Bi.	D.	Purple	T.	M.
B. Y. Morrison	Sturtevant	White	Bi.	M.	Pale lavender-purple	M.	M.
*California Blue	Essig	Blue	S.	M.		T.	M.
Cameliard	Sturtevant	Yellow	Bi.	M.	Bronzed-purple	T.	M. L.
Candelight	Andrews	Blue	S.	L.	Lavender-pink	T.	M.
Caprice	Vilmorin	Red	S.	M.		S.	E.
Cardinal	Bliss	Red	Bi.	D.	Lavender-rose	M.	M.
Carfax	Bliss	Red	S.	M.		T.	M.
C. E. Stringer	J. Sass	Pink	S.	L.		M.	M.
Cavatina	Williamson	Blue	Bl.	M.	Gold-lavender	T.	M.
Chalice	Sturtevant	Yellow	S.	D.		M.	E. M.
Chartier	Hall	White	S.	M.	Clear	M. S.	E. M.
Chasseur	Vilmorin	Yellow	S.	L.	Clear	M.	M.

*Listed in a recent symposium (Am. Iris Soc., Bul. 49: 54-55, 1933) as generally dependable.

TABLE 1 (*continued*)

Variety name	Originator	Color				Height	Season
		Main	Type	Depth	Secondary		
Chief	J. Sass	Blue	S.	D.	White veins	M. S.	E.
*Cinnabar	Williamson	Red	Bi.	D.	Purple-red	T.	L. M.
Cirtonella	Bliss	Yellow	Bi.	D.	Chestnut	M.	M.
Clara Noyes	H. P. Sass	Yellow	Bl.	D.	Apricot-rose	T.	M.
*Coppersmith	Shull	Red	Bl.	M.	Bronze	T.	M.
*Coronation	Moore	Yellow	S.	D.		T.	M.
*Corrida	Millet	Blue	S.	L.		S.	M.
Cyrus	H. P. Sass	Yellow	S.	M.	Veined	M.	E.
Damozel	Morrison	White	Pl.	M.	Blue markings	T.	M. L.
*Dauntless	Connell	Red	Bi.	D.	Pink-red purple	T.	M.
Député Nomblot	Cayeux	Red	Bi.	D.	Rose-purple	T.	M.
*Desert Gold	Kirkland	Yellow	S.	M.		M.	M.
*Dolly Madison	Williamson	Pink	Bi.	L.	Light dull violet	T.	M.
Dominion	Bliss	Blue	Bi.	D.	Blue-indigo	M.	L. M.
Dorothy Dietz	Williamson	White	Bi.	D.	Blue	T.	M.
*Dream	Sturtevant	Pink	S.	L.	Gold beard	T.	M.
Duke of Bedford	Bliss	Blue	S.	D.		T.	M.
Duke of York	Perry	Blue	S.	L.		T.	M.
Edgewood	Hall	Pink	Bi.	L.	Red veined	T.	L.
Edouard Michel	Verdier	Red	S.	D.	Petunia violet	M.	M.
El Capitan	Mohr-Mitchell	Blue	S.	L.		T.	M.
Elsinore	Hall	Yellow	Bl.	L.	Light lavender	M.	E. M.
Endymion	Sturtevant	Yellow	Bl.	L.	Golden bronze	T.	M.
Euphony	H. P. Sass	Yellow	Bl.	D.	Buff	M.	M.
Evadne	Bliss	Pink	S.	D.	Old Rose	M.	M.
Fire God	Nicholls	Red	Bl.	D.	Old gold	M.	M.
Flammenschwert	Goos and Koenemann	Yellow	Bi.	D.	Maroon	T.	E. M.
Florentina	Native of Italy	White	S.	L.	Pale blue cast	M.	E.
Fra Angelico	Vilmorin	Yellow	Bl.	L.	Olive-gold	M.	M.
*Frieda Mohr	Mohr-Mitchell	Pink	Bi.	L.	Two-tone rose	T.	L. M.
Gabriel	Bliss	Blue	S.	M.		T.	M.
Gay Huzzar	Williamson	Yellow	Bi.	D.	Mahogany red	S.	M.
Geo. J. Tribolet	Williamson	Red	Bl.	D.	Red-purple	T.	M. L.
George Yeld	Perry	Red	Bi.	M.	Apricot-rose	T.	M.
*Germaine Pertuis	Millet	Blue	Bl.	D.	Violet-purple	T.	L. M.
Gleam	Nicholls	Blue	S.	L.	Orange beard	T.	M.
Glowing Embers	Sturtevant	Red	Bi.	D.	Pink-red brown	T.	L.
*Gold Imperial	Sturtevant	Yellow	S.	D.	Clear	M.	M.
Gold Standard	Edlmann	Yellow	S.	L.		T.	M.
Gold Top	Salbach	Yellow	Bi.	M.	Red-violet	T.	E. M.
Grace Sturtevant	Bliss	Red	S.	D.		M.	M.
Harriet Presby	Presby	Pink	S.	M.	Rose lilac	T.	M.
Henri Rivière	Millet	Yellow	Bi.	L.	Mauve	T.	L.
Hypnos	Connell	Pink	Bl.	M.	Mallow pink-yellow	M. T.	M.
Imperator	Cayeux	Red	S.	M.	Red-purple	T.	L.
*Indian Chief	Ayres	Red	Bl.	M.	Two-tone red	T.	M.
Ingeborg	Goos and Koenemann	White	S.	L.	Cream white	S.	E.
Irma Pollock	H. P. Sass	Red	Bl.	D.	Magenta	M. T.	M.
Jacqueline Guillot	Cayeux	Blue	S.	L.	White beard	M.	L.
Jane Williamson	Williamson	Pink	Bl.	L.	Lavender	T.	M.
Jubilee	J. Sass	White	Pl.	L.	Gold-pink	M.	M.
Julia Marlowe	Shull	Pink	S.	M.	Red-pink	T.	E.
Kashmir White	Foster	White	S.	M.	Yellow beard	T.	E. M.
King Karl	J. Sass	White	Pl.	M.	Pink-cream	M. S.	M.
King Tut	H. P. Sass	Red	Bi.	D.	Yellow	M.	M.
Klamath	Kleinsorge	Blue	Bl.	D.	Violet	T.	L. M.
La Neige	Verdier	White	S.	D.	Gold beard	M.	E.
*Lent A. Williamson	Williamson	Blue	Bi.	D.	Lavender-purple	T.	E.
Lenz-schnee	Goos and Koenemann	White	Bl.	L.	Pale violet	M.	M.
Lodestar	Hall	Yellow	Bi.	D.	Brown	M.	M.
Lona	J. Sass	White	Pl.	M.	Purple on buff	M.	M.
Lord Lambourne	Perry	Red	Bi.	D.	Bronzed rose	T.	L. M.
Lord of June	Yeld	Blue	Bi.	M.	Two-tone blue	T.	M. L.
*Los Angeles	Mohr-Mitchell	White	Pl.	D.	Pale blue marks	T.	M.

*Listed in a recent symposium (Am. Iris Soc., Bul. 49:54–55, 1933) as generally dependable.

TABLE 1 (*continued*)

Variety name	Originator	Color				Height	Season
		Main	Type	Depth	Secondary		
Majestic	Bliss	Blue	Bi.	D.	Two-tone blue	M.	M.
Maori Princess	Shull	Yellow	Bi.	D.	Chestnut	M.	L.
Mareschal Ney	Williamson	Red	Bl.	D.	Purple	T.	M.
Marquisette	Cayeux	Pink	S.	L.	Shrimp pink	T.	M.
Marsh Marigold	Bliss	Yellow	Bi.	D.	Carmine	S.	E.
*Mary Barnett	Cumbler	Blue	S.	L.	Gold beard	M.	M.
Mary Gibson	Perry	Pink	Bl.	L.	Buff-pink	T.	E. M.
Medrano	Vilmorin	Red	Bl.	D.	Red-purple	M.	M.
Melchior	Wallace	Red	Bl.	M.	Pink-brown red	T.	M.-L.
Micheline Charraire	Denis	White	Pl.	M.	Golden halft	M.	M.
*Midgard	H. P. Sass	Pink	Bl.	L.	Yellow-pink	M.	E. M.
*Mildred Presby	Farr	White	Bi.	M.	Pansy violet	M.	E. M.
Mlle. Schwartz	Denis	Blue	Bl.	L.	Mauve pink	T.	M.
Mme. Cheri	Sturtevant	Pink	S.	M.		T.	M.
Mme. Henri Cayeux	Cayeux	Red	Bi.	D.	Purple	T.	M.
Moa	Bliss	Blue	Bi.	D.	Violet-purple	T.	L. M.
Montour	Hall	Red	Bi.	D.	Rose-purple	M.	M.
Moonlight	Dykes	White	S.	L.	Cream-pale blue	M.	E. M.
*Morning Splendor	Shull	Red	S.	D.	Red, purple	T.	M.
Mother of Pearl	Sturtevant	Blue	Bl.	L.	Mauve	T.	M.
Mrs. Andrist	Fryer	White	Bi.	M.	Pansy purple	M.	M.
Mrs. A. S. Hoyt	J. Sass	White	Pl.	M.	Pink cast	M.	M.
Mrs. Hetty Matson	Perry	Blue	Bi.	M.	Red-purple	M.	M.
Mrs. Horace Darwin	Foster	White	S.	D.	Chestnut veins	M.	E. M.
Mrs. R. Emmet	Perry	White	S.	M.	Yellow beard	T.	M.
*Mrs. Valerie West	Bliss	Red	Bl.	D.	Brown-red	T.	M.
Nancy Orne	Sturtevant	Pink	Bi.	M.	Two-tone pink	M.	M.
Nebraska	H. P. Sass	Yellow	S.	D.	Chestnut marks	T.	M. L.
Newtonia	Donahue	Pink	Bl.	L.	Lavender	T.	M.
Numa Roumestan	Cayeux	Red	Bl.	M.	Deep red	T.	M. L.
Nusku	Nesmith	Pink	Bl.	M.	Apricot rose	T.	M.
Nymph	H. P. Sass	Yellow	S.	M.		M.	V. E.
Odaroloc	Andrews	Blue	Bl.	L.	Pale blue-mauve	T.	L.
*Opaline	Williamson	Pink	Bl.	L.	Pale yellow	T.	M.
Ophelia	Cayeux	Yellow	Bl.	L.	Pale pink	M.	M.
Orchid	Shull	Yellow	Bl.	L.	Lavender	M.	M.
Pacific	Essig	Blue	S.	L.		M.	M.
Parc de Neuilly	Verdier	Blue	S.	D.	Lavender blue	M.	M.
Peau Rouge	Cayeux	Red	Bl.	D.	Red-purple	M.	M.
*Persia	Ayers	Blue	Bl.	M.	Olive grey	T.	M.
Phosphor	Shull	Yellow	S.	M.	Golden yellow	T.	M.
Picador	Morrison	Yellow	Bi.	D.	Buff-carmine	T.	M.
*Pink Satin	Sass	Pink	S.	M.		T.	M.
Pioneer	Bliss	Blue	Bl.	D.	Red-purple	T.	L.
*Pluie D'Or	Cayeux	Yellow	S.	M.	Clear	T.	M.
Prairie Gold	H. P. Sass	Yellow	S.	D.	Clear	M.	M.
*Primrose	Sturtevant	Yellow	S.	M.	Two-tone yellow	T.	M. L.
*Princess Beatrice		Blue	S.	L.		T.	E.
Prosper Laugier	Verdier	Red	Bi.	D.	Bronzed pink-purple	M.	M.
Prospero	Yeld	Blue	Bi.	D.	Red-purple	T.	M. L.
*Purissima	Mohr-Mitchell	White	S.	M.		T.	M.
Purple Haze	H. P. Sass	Blue	Bl.	M.	Grey-blue	M.	M.
*Queen Caterina	Sturtevant	Blue	Bl.	L.	Mauve	T.	M.
Quevera	J. Sass	Yellow	Bl.	L.	Buff	M.	M. L.
*Rameses	H. P. Sass	Yellow	Bl.	D.	Old gold-pink	M.	M.
Rayo de Sol	Mohr-Mitchell	Yellow	S.	M.	Two-tone yellow	T.	M. L.
Red Elf	Nicholls	Red	Bi.	D.	Deep pink-ox blood	S.	E.
Reverie	Sturtevant	Pink	S.	M.	Lavender	M.	M.
Redwing	H. P. Sass	Red	Bi.	M.	Red-purple	M.	M.
René Cayeux	Cayeux	White	Bi.	M.	Rose-purple	M.	M.
Rhea	Williamson	Pink	Bl.	M.	Mauve-gold	T.	L.
*Rheingauperle	Goos and Koenemann	Pink	S.	L.	Orchid pink	M.	M.
Rhein Nixe	Goos and Koenemann	White	Bi.	M.	Red	T.	M.
Rialgar	Sturtevant	Yellow	Bi.	D.	Chestnut veins	M.	L.
Robert W. Wallace	Perry	Blue	Bi.	D.	Purple	T.	L.
*Romola	Bliss	Pink	Bi.	M.	Lilac-red	T.	M. L.

*Listed in a recent symposium (Am. Iris Soc., Bul. 49: 54–55, 1933) as generally dependable.

TABLE 2 (*concluded*)

Variety name	Originator	Color				Height	Season
		Main	Type	Depth	Secondary		
Rose Madder	Sturtevant	Red	Bi.	D.	Purple	M.	M.
Sacramento	Mohr-Mitchell	White	Pl.	D.	Pink marks	M.	M.
*San Francisco	Mohr-Mitchell	White	Pl.	M.	Blue	T.	M.
*Santa Barbara	Mohr-Mitchell	Blue	S.	L.	Grey blue	T.	M.
Santa Fe	Mohr-Mitchell	Blue	S.	L.	Palest blue	M.	M.
Sea Dawn	Nicholls	Pink	Bl.	L.	Coppery-yellow	M.	M.
*Seminole	Farr	Red	Bi.	D.	Orange beard	T.	M.
*Sensation	Cayeux	Blue	S.	M.	Blue violet	T.	M.
Shasta	Mohr-Mitchell	White	S.	M.	Cream cast	T.	M.
Shekinah	Sturtevant	Yellow	S.	L.		T.	M.
*Sir Michael	Yeld	Blue	Bi.	D.	Lavender-purple	T.	M.
*Snow White	Sturtevant	White	S.	D.		T.	M.
Soledad	Mohr-Mitchell	Yellow	S.	L.		M.	E.
Solitaire	Nicholls	White	S.	D.	Gold beard	M.	M.
Sonata	Williamson	Yellow	Bl.	L.	Mauve	T.	M.
*Souv. de Loetitia Michaud	Millet	Blue	S.	L.	Pale lobelia blue	T.	M.
*Souv. de Mme. Gaudichau	Millet	Blue	Bi.	D.	Dark blue	T.	E.
Spark	Nicholls	Red	Bi.	D.	Two-tone red	S.	E.
Starsong	Morrison	Yellow	Bl.	M.	Lavender	S.	E.
Sunlight	Sturtevant	Yellow	S.	L.		M.	M.
*Susan Bliss	Bliss	Pink	S.	L.	Red-pink	T.	M.
Swazi	Bliss	Blue	Bi.	D.	Two-tone blue	M.	M.
*Sweet Lavender	Bliss	Blue	Bl.	L.	Lavender	T.	M.
Tenebrae	Bliss	Red	Bl.	D.	Red-purple	M.	E.
Thais	Cayeux	Pink	S.	L.	Orchid pink	T.	E. M.
Tid-Bit	Sturtevant	Blue	S.	M.		S.	E. M.
Tokay	Nicholls	Pink	Bl.	L.	Yellow	T.	M.
Tom Tit	Bliss	Blue	S.	D.		S.	E.
Trojana	Species	Blue	Bi.	M.	Two-tone violet	T.	M. E.
*Tropic Seas	Shull	Blue	Bi.	M.	Two-tone blue	T.	E.
Trostringer	H. P. Sass	Pink	S	L.	Pale rose pink	T.	M.
*True Charm	Sturtevant	White	Pl.	M.	Lavender marks	T.	M.
True Delight	Sturtevant	White	Pl.	M.	Pink marks	T.	M.
Tuscany Gold	Williamson	Yellow	Bl.	L.	Golden buff	M.	M.
Valencia	Mohr-Mitchell	Yellow	Bl.	L.	Old Gold	M.	M.
*Van Cleve	Van Name	Blue	Bi.	D.	Two-tone blue	T.	M. L.
Vesper Gold	Williamson	Yellow	Bl.	L.	Old gold	T.	M.
Waconda	H. P. Sass	Red	Bl.	D.	Bronzed purple	T.	M. L.
*Wambliska	J. Sass	White	Pl.	M.	Blue suffusion	M.	M.
Wedgewood	Dykes	Blue	S.	M.	White beard	T.	L.
White and Gold	Nicholls	White	S.	D.	Gold beard	T.	M.
White Knight	Saunders	White	S.	M.	Chestnut veins	M.	E. M.
White Queen	Geylenkek	White	S.	M.	Cream beard	M.	M.
William Mohr	Mohr-Mitchell	Pink	S.	M.	Pink veins on white ground	M.	M.
*Yellow Moon	Sturtevant	Yellow	S.	L.		M.	M.
Zada	Emigholz	White	S.	D.	Gold beard	T.	M.
Zingara	Williamson	Yellow	Bi.	M.	Two-tone yellow	T.	L.
Zulu	Bliss	Blue	Bi.	D.	Two-tone blue	T.	L.

*Listed in a recent symposium (Am. Iris Soc., Bul. 49: 54–55, 1933) as generally dependable.

DWARF AND FALL-BLOOMING IRIS

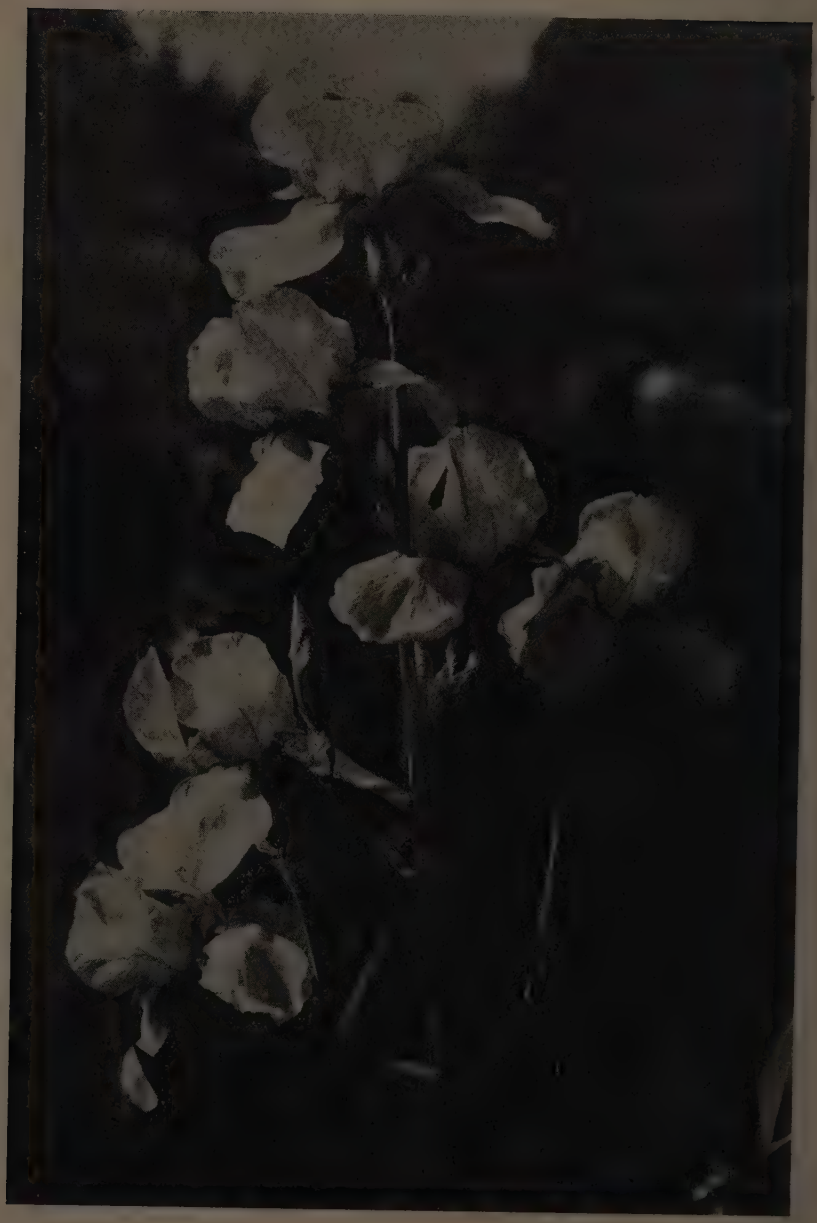
I. PUMILA and its derivatives flower early in May and are particularly attractive in the rock garden where they form dense mats of bright blue, purple, crimson, white, or yellow blossoms in a few years.

The soil pockets in which they are planted should be filled with soil thoroughly enriched in organic matter. The plants are shallow-rooted and are rapid growers, soon depleting the soil of its fertility.

The varieties Coerulea (Prince, 1829), light blue; Florida (—), pale yellow; Graminea (Bonnewitz, 1920), rich red-violet; Pumila atroviolacea (Todaro, 1856), deep violet; Schneekuppe (Goos and Koenemann, 1910); white; and Socrates (—), claret purple; make a brief list representative of the general color range of this group of iris.

PHOTOGRAPH BY J. C. NICHOLLS

FIGURE 8. IRIS EQUINOX, A REPRESENTATIVE OF THE FALL-BLOOMING GROUP OF IRISES



PHOTOGRAPH BY CARL SALBACH

FIGURE 9. SAN FRANCISCO

This iris has a large pure white flower with a distinct blue edge

PHOTOGRAPH FROM CARL SALBACH

FIGURE 10. WM. MOHR

This novel and interesting variety has exceptionally large flowers that are pale lilac in color and are veined and dotted

PHOTOGRAPH FROM J. C. NICHOLLS

FIGURE 11. WM. MOHR

Dwarf irises may produce a second crop of bloom in the fall of the year, generally through October. The quantity of bloom is always less than that produced in the spring, at least in Ithaca.

The tendency to flower in the fall has been noted in a number of varieties of the intermediate- and tall-bearded groups. As a general rule this is characteristic of only the earliest varieties, and many of these are among the older ones. Several hybridizers are now working to intensify this characteristic and to produce a race of fall-blooming iris.

CULTURE OF IRIS

BEARDED iris will thrive in a wide variety of soils but will do best in a medium-heavy loam. Excellent specimen plants carrying an unusual mass of bloom are often found growing on the heaviest of clay soil. Large plants with especially vigorous root systems are characteristic of sand or gravelly loam.

Soil fertility is important, for, while plants will grow for long periods in poor soils, thrifty plants are found only in soils of better-than-average fertility. Improvement of soil fertility by the addition of organic matter should be done well in advance of the actual planting so that the material will be thoroughly incorporated in the soil body before the irises are set. Bone meal is frequently recommended as the best fertilizer for irises, but it might well be replaced by superphosphate as this fertilizer is more readily available and supplies the same necessary chemical elements as does bone meal.

PHOTOGRAPH FROM J. C. NICHOLLS

FIGURE 12. PURRISSIMA

This iris has a large, white flower. The plant is vigorous but must be planted in well-drained soil

The mechanical preparation of the soil requires careful study with reference to drainage. Iris will not thrive in wet or water-logged soils. In some instances it will be necessary to provide special drainage by digging out the soil to a depth of 18 to 24 inches and providing a 4-inch layer of gravel or broken tile. Another method is to make raised beds, either by bringing in soil from outside or by digging the surface soil from the walks. The beds should be from 4 to 6 inches above the surrounding level.

Iris must be planted in a sunny location for best results. Plantings on the north side of the house or in other equally shaded places seldom thrive;

the plants grow and flower indifferently. Shrubs and perennials make an ideal background and ideal companion plants but the iris must be planted far enough away from them so that the roots of these plants do not rob the soil of its fertility or the foliage shade the iris for long periods during the day.

Deep preparation of the soil is essential, for the plants have to remain in the one location for at least three years and are often left for a much longer period before replanting. The iris is typically shallow-rooted, but many of the feeding roots penetrate to a depth of 18 inches or more. When possible, the soil should be spaded deeply in the fall of the year and left over winter before the iris are set.

PHOTOGRAPH FROM J. C. NICHOLLS

FIGURE 13. CARDINAL

This iris, lavender-purple bicolor, has the heavy-textured florets and short well-branched stem typical of the Dominion group

The best time to plant iris is during the summer immediately after the flowering period. Plants set at this time or as late as September will become well established before winter. Plants set in the late fall are likely to heave during the winter. Spring planting eliminates this possibility but there is less chance of the plants flowering during the first season than when they are set during the summer. Iris cannot be relied upon to flower abundantly until the second or third season after planting.

When the gardener wishes a mass effect immediately, the plants are sometimes set as close as 8 inches. While this practice may temporarily meet the need, it is seldom satisfactory because the plants soon become crowded and growth and vigor are impaired. Rhizomes should be set at least 18 inches apart and 2 feet is not too great a distance.

In mature clumps the rhizomes spread out fan-like and are half embedded in the soil. In planting iris it is well to remember this and not to bury the

PHOTOGRAPH FROM J. C. NICHOLLS

FIGURE 14. LOS ANGELES

The large flower is almost pure white in color; the base of the standards is edged with pale blue. The stalks are tall, and the plant is a vigorous grower

rhizomes deeply; such practice encourages rot, which may be fatal. As the rhizomes are received from the nurseryman some of the fibrous roots which normally extend downward and forward from the rhizome will be found in a dried condition. Although they may never again function as living roots, they can be relied upon to anchor the plant in place until

new roots develop. A new set of these fibrous roots forms immediately after the plant has flowered, making this particular time ideal for planting.

After the fibrous roots have been spread through the soil, the rhizome should be firmed into place. If the season is particularly dry, the new planting should be watered each day until the new roots are well established. This is seldom necessary, however, and the plants rapidly establish themselves without further aid.

The iris bed should be kept free of weeds at all times. Hand-weeding is the surest method of obtaining good results. The spaces between plants can be kept clean with the hoe, but in the immediate neighborhood of the rhizome the work should be done by hand. This not only ensures a better job but the rhizomes are not injured and are not exposed unduly to rot.

Grass is one of the worst weeds in the iris garden. It not only competes seriously for plant food but keeps the rhizome moist and is difficult to eradicate when it once gets a foothold. Another important weed is the iris itself. The plants grow so rapidly that they soon become crowded, deplete the soil fertility, and harbor insects and plant diseases. As soon as crowding is evident, the plants should be lifted, divided, and set in a new location. Most plantings will remain in good condition for five years.

PHOTOGRAPH FROM J. C. NICHOLLS

FIGURE 15. WHITE AND GOLD

The flower is ivory white, with yellow beard. This is a hardy, fast grower

Old or crowded plantings can be renovated by lifting and dividing the clumps. The divisions should be set in a new location, or, if this is not possible, the soil should be thoroly spaded before resetting the plants.

A whole clump of iris can be dug by cutting under it with a spade or mattock. The soil should then be shaken or washed out as much as possible. Clay soils are especially tenacious. The clump may have to be forcibly handled or the soil washed out by a stream of water from a hose pipe.

In dividing the clump, the rhizomes can be cut away till each fan of leaves has but a short sound piece of rhizome with a number of

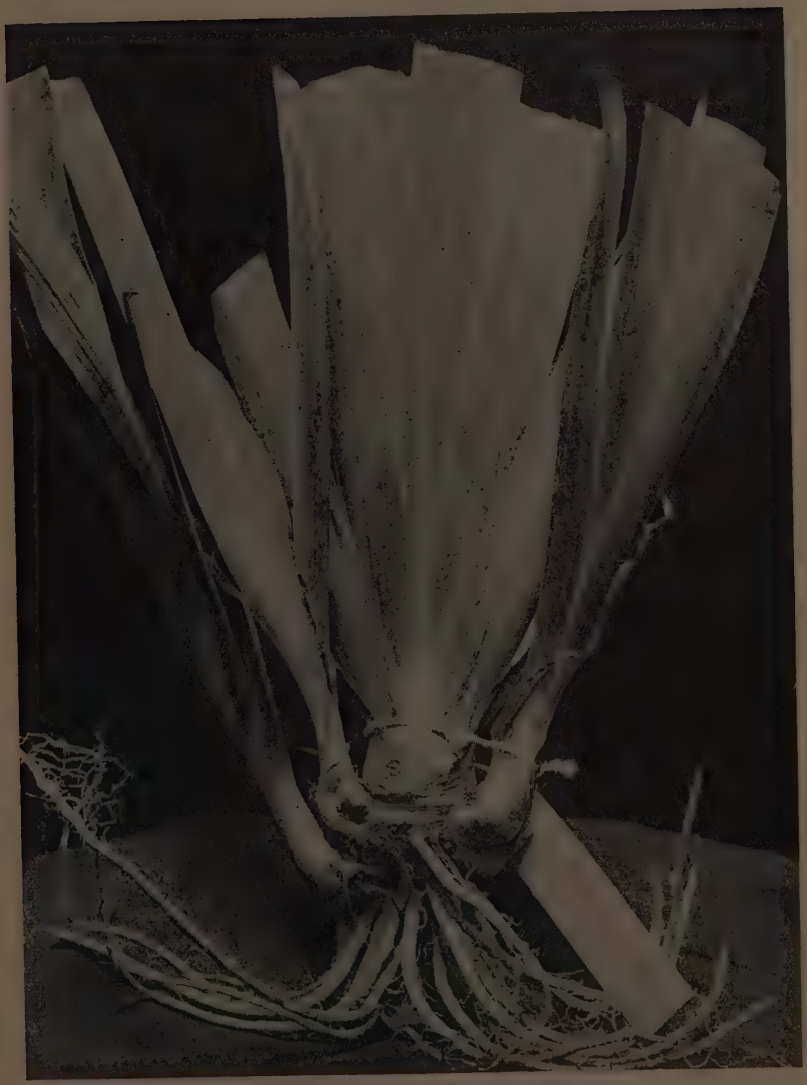


FIGURE 16. AN IDEAL DIVISION FROM A STRONG-GROWING PLANT

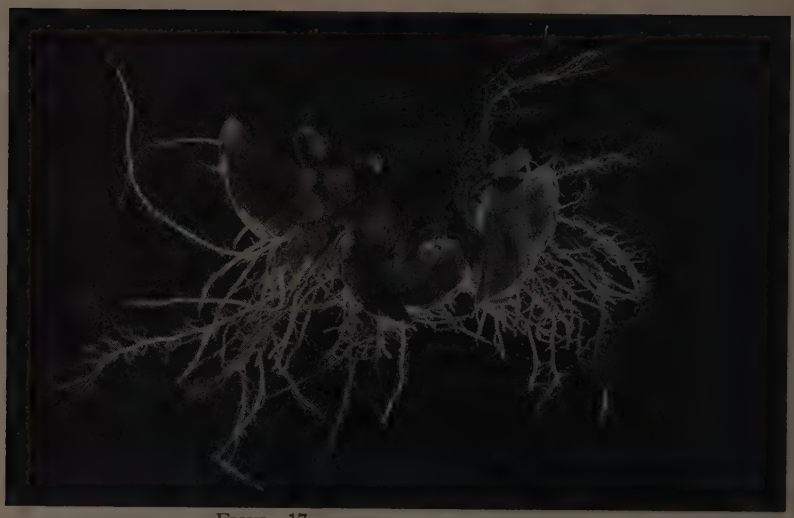


FIGURE 17. SECTION OF AN IRIS CLUMP

The soil has been washed from the old rhizome, and the feeding roots, which form shortly after the growing season, are exposed

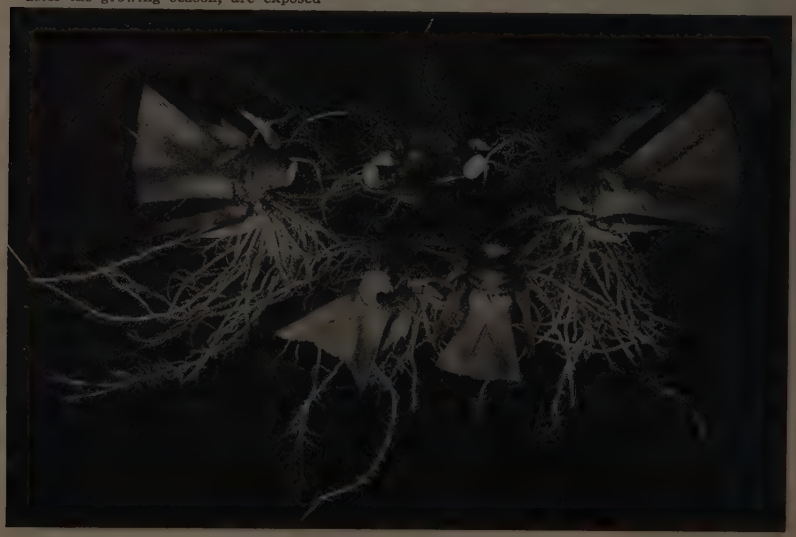


FIGURE 18. SECTION OF THE IRIS CLUMP SHOWN IN FIGURE 17, WITH FOUR DIVISIONS, OR FANS

The dark area in the upper left portion of the third fan from the right is diseased tissue. Before planting, this tissue must be cut out and the rhizome sterilized as suggested in the discussion of soft rot (page 30)

FIGURE 19. THE FALL FOLIAGE (UPPER) SHOULD BE CUT BACK TO WITHIN A FEW INCHES OF THE GROUND (LOWER)

Grass and weeds should be pulled up, leaving the clump clean for winter, and allowing the sun full play on the rhizomes. This helps to keep the planting in a vigorous, healthy condition

vigorous feeding roots. The foliage should then be cut out to within 6 to 8 inches of the rhizome. Dead or diseased leaves should be removed. The healthy fan, or division, is then ready for planting, trade, or sale, as the case may be.

If rhizomes are to be shipped, the name of the variety should be attached to each division. Wired labels are ideal for this purpose as the wires can be forced through the base of the leaves and twisted together. Dry packing material, such as excelsior, should be used as padding to protect the rhizomes from being crushed in transit. Most growers prefer to use cardboard cartons with holes punched in them for ventilation; some pack the rhizomes in a ball of excelsior and wrap it in corrugated paper, using ordinary brown store paper for the outside wrapping. Before shipping iris, one should write to the Department of Farms and Markets, at Albany, New York, for information concerning inspection and permits. Plant-quarantine regulations vary from year to year so that no general statement can be made in this bulletin.

Immediately after the flowering season, the iris planting should be thoroughly weeded and cultivated. The old flower stalks can be removed, making the planting presentable for the remainder of the summer. Iris foliage will persist through rather severe frosts and the clumps will continue to grow till late fall. If the planting is young, the fall clean-up can be left till late in the season, but in mature clumps the foliage should be cut back and the clumps thoroughly weeded during October. Cultivation must be light in order to avoid injury to the roots and rhizomes.

Winter protection is seldom necessary. In the northern part of the State, a light covering of straw is usually sufficient. Dead leaves and other materials which will settle over the rhizome and remain damp for long periods should not be used. Plants which have been set in a low, poorly drained area frequently suffer and, if water lies over the plants during the winter or spring, serious injury is likely to result.

In the spring the soil should be forked over very lightly and the clumps weeded. Commercial fertilizers may be applied at this time. Superphosphate and muriate of potash are good. A 4-1 mixture of these fertilizers applied at the rate of half a pound for each square yard of planting is usually adequate. As flowering time approaches, watering will prove beneficial if the season is dry.

DISEASES OF IRIS

C. E. F. GUTERMAN

OF THE several diseases to which the rhizomatous iris is susceptible, Heterosporium leaf spot, bacterial soft rot, crown rot, Botrytis rhizome rot, rust, and mosaic are the most important.

FIGURE 20. PROGRESSIVE STAGES OF INFECTION WITH THE HETEROSPORIUM LEAF SPOT DISEASE

Heterosporium leaf spot

Heterosporium leaf spot, a common disease of the iris, is world-wide in its distribution. Although the disease is confined solely to the foliage and frequently does not appear in serious form until late in the summer, its importance should not be underestimated by the iris grower. Premature death of the leaves serves to reduce the amount of food available for storage in the rhizomes and thus weakens the plant. If this loss continues from year to year, the plants will eventually die. Aside from the loss of plants, the disease results in unsightly foliage with a consequent decrease in ornamental value.

Symptoms

Plants affected with Heterosporium leaf spot exhibit characteristic spots which may occur on both sides of the leaves (figure 20). The infections are first evident as minute brown spots surrounded by a water-soaked margin which later turns yellow. As the spots enlarge, the centers become gray and are dotted with black tufts of the fungus which break through the surface of the leaf. In general, the spots are oval or elliptical in shape with the longer axis parallel to the veins. If the infection is severe, the spots may coalesce to give the plant a burned or blighted appearance.

Cause

The disease is caused by the fungus *Didymellina macrospora* Kleb. whose conidial stage is *Heterosporium gracile* Sacc. The fungus overwinters on fallen infected leaves, and the spores produced on these leaves in the spring are disseminated by splashing rain and air currents as primary inoculum from which the early season infections arise.

Control

In attempting to control this disease, the importance of sanitation cannot be emphasized too much. A thorough removal and destruction by burning of all infected leaves in the fall will serve as a simple and effective means of eradicating the disease. Although spraying with bordeaux mixture has been advised as a possible means of control, it should be pointed out that the waxy upright foliage makes it difficult to obtain adherence of the spray. According to observations reported from England, lime-loving species of iris are seldom attacked by this fungus. Furthermore, control of the disease has been claimed by English workers through the use of top-dressings of slaked lime applied late in the fall or during the winter. When so used, the lime should be worked into the soil around the roots of the plants.

Bacterial soft rot

Aside from the iris, bacterial soft rot affects a wide variety of plants. Among the more common ornamentals may be mentioned callas and hyacinths. A large number of vegetables are also susceptible to the disease.

FIGURE 21. DECAY OF THE RHIZOME AND LEAF BASE CAUSED BY BACTERIAL SOFT ROT

Symptoms

As indicated by the common name, this disease results in a soft, malodorous rot of the rhizomes and of the lower leaf sheaths (figure 21). Leaves on infected plants may wilt and eventually collapse completely because of rot at the base. In plants where the decay is progressing more slowly, the leaves may die back gradually from the tips.

Cause

Soft rot is caused by a bacterium known as *Erwinia carotovora*. The bacteria overwinter in the soil and within infected plant debris. While infection occurs chiefly through wounds caused by borers, snails, wind-whipping, and cultivation, some evidence indicates that under favorable conditions the bacteria can gain entrance through natural openings such as stomata and lenticels. Splashing rain and flowing water play important rôles in disseminating the bacteria from diseased to healthy plants. It is also probable that certain insects are of importance in the spread of these bacteria.

Control

The most effective control of soft rot can be obtained during the month of August when the plants are ready for division. At this time the clumps should be lifted and divided. All rotted portions of the rhizomes should be carefully cut out and destroyed. The clean divisions should then be soaked in a 1–1000 solution of bichloride of mercury (corrosive sublimate) for ten minutes. A solution of the proper strength can be made by dissolving two 7½-grain tablets of the poison in a quart of water or by dissolving 1 ounce of the powder in 7½ gallons of water.

The treated plants should then be planted in a new location. If it does not seem practicable to change the location of the irises, the soil in the old beds should be replaced with new soil in which susceptible plants have not been grown. Since the bacteria which cause soft rot are very susceptible to drying and to sunlight as well, shallow planting, with the upper half of the rhizome above the surface of the soil, will aid considerably in preventing further trouble. A well-drained soil is desirable, and crowded or shaded situations should be avoided. Needless to say, the iris borer must be controlled and care must be taken when working among the plants to avoid any wounds which might afford a ready means of entrance to bacteria.

Crown rot

As was true with soft rot, the crown-rot disease is not confined solely to the iris. It is destructive on many garden flowers including lilies, delphinium, Hosta, Valerian, and Pyrethrum.

Symptoms

With irises, the first noticeable symptom of crown rot is a gradual die-back of the tips of the outer leaves. Further examination will reveal that the bases of these leaves have been rotted close to the soil line. As the disease progresses toward the center of the clump, the inner leaves begin to exhibit the die-back symptom and the plant is soon completely dead. So far as is known, the disease on irises is limited to the leaf and flower-stalk bases. The rhizomes are not attacked nor is the decay malodorous as is true with bacterial soft rot.

Cause

Crown rot is caused by a fungus known as *Sclerotium delphinii* Welch. This fungus can be detected between the rotted leaf bases where it forms a characteristic, white, fan-like vegetative growth. During rainy weather in mid- or late summer, the fungus forms large numbers of small seed-like bodies, called *sclerotia*, on the dead crowns or the surrounding soil. The sclerotia, when mature, are about the size of mustard seed or bird shot. They are white at first, gradually becoming cream and finally reddish brown in color. Spread to near-by healthy plants occurs when the sclerotia are washed around during heavy rains or are scattered by cultivation. It is in this form, also, that the fungus lives over the winter.

Control

Great care should be exercised not to introduce infected plants among the healthy irises already growing in the garden. Any divisions suspected of having this disease should be discarded or cleaned and soaked for ten minutes in a 1–1000 solution of bichloride of mercury.

If the disease appears suddenly during the early summer, severely infected plants should be carefully removed and destroyed and the surrounding soil drenched with a 1–2000 solution of bichloride of mercury (one 7½-grain tablet to each quart of water or 1 ounce of the powder to 15 gallons of water). In cases of partial infection, control has been obtained by drenching the crowns of the plants with the above solution or by dividing, cleaning, and treating the plants as described for soft rot.

The disease is frequently most serious when the irises are growing under crowded conditions. For this reason the plants should be divided at regular intervals and given adequate space for normal growth. If the disease continues to remain serious, it then becomes necessary to move the plants to a new location or to replace the old infested soil to a depth of 8 to 10 inches with clean, fresh soil.

Botrytis rhizome rot

Relatively speaking, the Botrytis rhizome rot is a recent disease and, while not so widespread as some of the other more common iris diseases, it seems to be increasing in extent and severity each year. For this reason, and because its effects are commonly ascribed to winter injury, it seems advisable to discuss the disease.

Symptoms

Botrytis rhizome rot destroys the plants during the winter and spring, making little or no development in the summer and early fall. Its presence is first noticed when the plants fail to grow in the spring or when they put forth a few weak shoots which later turn yellow and die by midsummer. Such plants are easily removed from the soil because of the death or decay of the roots (figure 22). The rhizomes are shriveled and partially or completely decayed, with the diseased tissue gray-brown in color and pithy in texture. The decay is not accompanied by any disagreeable odor.

Cause

This disease is caused by the fungus *Botrytis convoluta* Whet. and Drayton. The life history of the fungus is not clearly understood at the present time. Early in the spring, large numbers of conidia or spores are formed by the fungus on the exposed portions of the rotted rhizomes and at the bases of the leaf sheathes of the previous year's growth. At the same time large masses of characteristically convolute, shiny black sclerotia are to be found on the undersides of the rotted rhizomes and along the roots. Infection results from the conidia, and wounds seem to be necessary before the fungus can gain entrance into the plant tissues.

Control

The irises should be examined carefully early in the spring as soon as growth has started. Any plants which are sickly or have failed to grow should be dug up together with some of the surrounding soil. If the rhizomes and roots are rotted and the characteristic black sclerotia are present, the plants and the immediately surrounding soil should be destroyed. Until more is known about the disease, it would not be advisable to plant healthy irises in the same area unless the soil has been changed or sterilized.

Rust

A few varieties of irises, and certain species in particular, are susceptible to a disease called *rust*. Caused by the fungus *Puccinia iridis* (DC.) Rabh., the disease is characterized by orange-brown, powdery pustules of spore masses which appear in large numbers on the leaves. If infection is severe, the foliage may be killed back prematurely.

FIGURE 22. EFFECT OF BOTRYTIS RHIZOME ROT ON A RHIZOME AND ITS ROOTS
Note the convolute, black sclerotia on the underside of the rhizome

When present, the disease can be controlled by removing and burning all infected leaves late in the fall and thus prevent the fungus from overwintering. This practice should be supplemented the following season with several applications of dusting sulfur applied with a suitable hand duster.

Mosaic

While mosaic, a virus disease, is more severe in its effects on the bulbous iris types, some evidence indicates that rhizomatous irises may be stunted and gradually weakened as a result of infection. The symptoms consist of a characteristic mottling of the foliage with dark and light green areas. On bulbous iris, the flowers are markedly distorted and the plants are exceedingly stunted. With German iris, flower formation seems to be normal and the plants are only slightly stunted.

Since the virus which causes the disease is present in all parts of the plant, the only possible method of control consists of the removal and destruction of all infected individuals. Practically all virus diseases are disseminated by insects, and the destruction of the infected plants will effectively check further spread of the trouble.

INSECT PESTS OF IRIS

GRACE H. GRISWOLD

UNTIL recent years iris has been thought to be comparatively free from the attacks of insects. With the spread of the iris borer and the increasing damage caused by this pest, iris growers are becoming conscious of the injuries which insects may inflict. In the following paragraphs some of the more common insects that attack iris are discussed and measures for controlling them are suggested.

The iris borer

The iris borer (*Macronoctua onusta* Grt.) is probably the most injurious insect that attacks iris, causing more damage to this popular plant than all of its other insect foes combined. Not only is this borer an enemy on its own account, but the tunnels it makes in a rhizome are ideal places for the development of a serious iris disease (page 28). The iris borer attacks practically all kinds of iris, including the Japanese and the Siberian, although it appears to be more common in home gardens than in large field plantings. The injury is most evident during July and August. It is not always easy, however, to tell where the borers are at work. If the infestation is a heavy one, entire plants will be killed; but if there is only one borer in a rhizome, the damage may not be evident aboveground. There are several ways in which one can tell that borers are present. A plant may

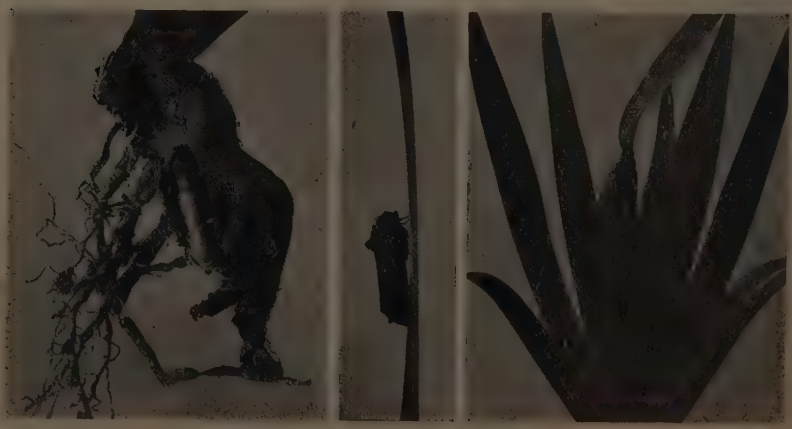


FIGURE 23. THE IRIS BORER AND ITS WORK

Left, Full-grown larva in an iris rhizome; center, adult moth on an iris leaf; right, iris foliage injured by newly-hatched larvae

have leaves that are loose and rotted at the base, so that they can be easily pulled off. A rhizome may be exposed, showing holes in the top which the borers have made. The leaves of the new growth may be small and poorly developed. Some of the leaves may have badly eaten places along the edges.

A careful study of the iris borer is being carried on at Ithaca and it is planned to publish a detailed report on this work in the near future. The adult borer is a medium-sized, night-flying moth, quite inconspicuous, for its coloring is mostly dark brown marked with black. The moths usually appear about the second or third week of September and are on the wing through October and even into November. They mate, and the females lay eggs which do not hatch until the following spring. The egg is a tiny object only about 1/50 of an inch across and less than half as high. When first laid the eggs are creamy-white, but eventually they become distinctly lavender. The eggs are laid in groups or clusters and are carefully glued down. In our studies, eggs have been found pasted to practically everything in the cages that had a roughened surface—twigs, dead leaves, rusty nails, cloth, bits of wood, and wire screen. Only in one instance were any eggs laid on fresh green iris leaves. A single female may lay as many as 600 or 700 eggs in 24 hours and a total of more than 1400.

As previously stated, the eggs do not hatch until the following spring, usually about the last of April or the first week in May in the vicinity of Ithaca. The newly hatched larvae are tiny creatures, only about $\frac{1}{16}$ of an inch in length. Almost at once they crawl up the iris plants and make small holes like pin pricks in the leaves. Then each larva gnaws out the soft tissue between the upper and the lower surface of the leaf, crawls inside, and becomes a leafminer. Later it works down towards the base of the plant, chewing the edges of newly developing leaves. Finally, it gets to the rhizome where it makes great tunnels. At this time the borer is about $1\frac{1}{2}$ inches long, has a reddish-brown head and a body that is distinctly pinkish. The larva eventually leaves the rhizome and goes into the soil to pupate. Pupation lasts for about five weeks and, as previously stated, the adult moths begin to appear about the middle of September.

Control

Iris plants should be carefully watched during the summer months. If there is any evidence that borers are at work, the plants should be dug up, the borers removed and destroyed, and the rhizomes carefully cleaned before being reset. Any rhizomes that are at all rotted should be given special attention, as explained on page 30.

In fighting the iris borer a thorough clean-up of the garden late in the fall and again early in the spring is most essential. (See page 26.) Since egg clusters are glued to dead leaves and other debris, all possible trash

should be removed and burned. Some growers have found it effective to burn over their iris plantings late in the fall or early in the spring. This should be done with a quick, hot fire. An old broom dipped in kerosene will make a good torch which can be swung back and forth over the ground about the plants; or one can cover the plants with a light coating of dead leaves or straw and then apply a match here and there. Unfortunately, burning-over the plants seems to injure certain types of iris.

Another method of control is to spray the iris foliage early in the spring with arsenate of lead. Many of the little newly hatched larvae will be killed by the poison when they crawl up the plant and chew holes in the sprayed leaves. The following combination makes a good spray: 1 ounce of arsenate of lead, ¼ ounce of casein, and 1 gallon of water. If casein is not available, a tablespoonful of sour milk may be used instead. The mixture must be thoroughly stirred before it is applied. Two or three applications should be made at weekly intervals beginning about the middle of April in the vicinity of Ithaca, and earlier in the southern part of the State.

The verbena bud moth

The verbena bud moth (*Olethreutes hebesana* Walk.) causes injury to a number of flowering plants, among which are verbena, snapdragon, closed gentian, beard tongue, and iris. The damage is caused by the larvae which bore in the stem, or attack the seed pods, depending on the time of year and on the type of plant attacked. On iris, the injury seems to be confined mostly to the seed pods. Therefore, the insect may be considered a pest of iris only where growers are anxious to have their plants produce seeds. The biology of this insect has been studied by Fink[1] and by Ries[2]. The adults, small brownish moths, lay eggs on the surface of the seed pods. After the eggs have hatched the tiny larvae bore into the pods where they cause considerable damage to the seeds. The young larvae are somewhat greenish in color but as they grow and become mature the larvae are darker and browner. After a pupal stage of from twelve to fourteen days, the adult moths emerge. In New York State there are said to be three or four generations a year, while in Virginia there may be at least five or six generations. The insect spends the winter as a larva or pupa hidden in a seed pod or stem of one of its various host plants.

Control

As previously stated, the eggs of this insect are deposited on the surface of the plant; in the case of iris, on the outside of the seed pods. If the seed pods are treated with a poison spray, many of the small larvae will be killed by the poison before they bore their way into the pods. The follow-

[1]Fink, D. E. The verbena bud moth. U. S. Agr. Dept. Bul. 226:1–7. 1915.
[2]Ries, Donald T. Verbena bud moth. *In* Two iris insects. American Iris Society. Bul. 32:39–46. 1929.

ing two sprays have been found satisfactory: (1) 2 ounces of arsenate of lead, 2 ounces of fish-oil soap, and 3 gallons of water; (2) 2 ounces of arsenate of lead, ½ ounce of casein, and 3 gallons of water. If casein is not available, sour milk may be used instead, as explained on page 36. The spray should be applied as soon as the seed pods have formed, and a second application should follow a week or 10 days later.

Bags made of fine cheesecloth securely tied over the seed pods should prevent the adults from depositing eggs on the surface of the pods. Since this insect lives over winter as a larva or pupa in the stems and seed pods of its various host plants, it is essential that all such plant remains should be raked up and burned.

The iris weevil

A small beetle, *Mononychus vulpeculus* Fab., commonly called the "iris weevil", "flag weevil", or "iris snout beetle," has been recorded as feeding on the blossoms of cultivated iris, sometimes disfiguring them considerably. The beetles have also been found injuring the seed pods by making small punctures on the surface. One worker states that "after a few days these punctures became calloused and appeared as rough, corky irregular scars." According to Needham,[3] who studied this beetle in Illinois many years ago, the iris weevil commonly breeds in the seed pods of the larger blue flag (*Iris versicolor*). He found that the female lays eggs in punctures which she makes in the walls of the flag ovary and that the larval life of the insect is spent inside the seed pod. There the larvae, small fat grubs, cause considerable damage by feeding on the seeds. Eventually pupation occurs inside the seed pod, and the adults emerge when the pods burst open. There is only one generation a year. The insects hibernate as adult beetles which become active the following spring when the flags begin to bloom. The iris weevil is a small beetle, less than ¼ of an inch in length. Its general color is black but the under part of its body is covered with whitish-yellow scales. Its mouthparts are at the end of a long black snout. The beetle is thus well adapted for making punctures in iris flowers and seed pods. This insect is common in New York State and may be causing more injury to cultivated iris than is generally supposed.

Control

It would probably be difficult to devise a satisfactory method for preventing adult beetles from eating holes in the petals of iris blossoms. To spray the flowers with an insecticide would detract from their appearance quite as much as does the work of the beetles. Unless one wishes to obtain seeds, all flower heads should be cut off and destroyed as soon as they be-

[3] Needham, James G. The fruiting of the blue flag (*Iris versicolor* L.). Amer. Nat. 34:361–386. 1900.
Needham, James G. Some general features of the metamorphosis of the flag weevil *Mononychus vulpeculus* Fabr. Biol. Bul. 1:179–191. 1900.

gin to fade, thus preventing any beetles from developing in the seed pods. Where iris is being grown for seed purposes, the appearance of the plants is of secondary importance. Covering the blossoms with bags of fine cheesecloth should keep the beetles away and thus prevent the deposition of eggs. In Canada this method has been used with considerable success. Spraying the flowers and pods with arsenate of lead, as suggested for the verbena bud moth (page 36) might also prove effective. Since the insect lives over winter as an adult beetle, one method of control would be to rake up and burn all debris about iris plantings either late in the fall or early in the spring.

Aphids

Plant lice, or aphids, are well-known pests familiar to most gardeners. These small insects attack nearly all kinds of flowering plants. When present in large numbers they cause considerable injury by puncturing the foliage and sucking out the juices. In addition to this type of damage, certain aphids act as carriers of some of our common plant diseases. Several species of plant lice have been found on iris. Among them are the green peach aphid (*Myzus persicae* Sulz.), the pink and green potato aphid (*Illinoia solanifolii* Ashm.), and the lily aphid (*Myzus circumflexus* Buckt.). It has been proved that both the green peach aphid and the potato aphid act as carriers of a mosaic disease which is sometimes very destructive to plantings of Spanish and Dutch iris. Another plant louse recorded on iris is the tulip, or iris, aphid, (*Anuraphis tulipae* Boyer). The insect is also called the "storage aphid" because of its habit of attacking various kinds of bulbs that are stored over winter. Although this aphid more commonly attacks bulbous iris, it has been found on iris of the rhizome type, especially in shipments coming from Europe.

Control

Aphids can be readily killed by spraying with nicotine-sulfate, 2 teaspoonfuls to 1 gallon of water in which an ounce of soap has been dissolved. Where aphids are found on plants that have been stored or that have been received in shipment, the rhizomes can be immersed in this solution instead of being sprayed with it. A 3- or 4-per-cent free nicotine dust is also effective in killing aphids and is somewhat simpler to apply than the spray.

The gladiolus thrips

The gladiolus thrips (*Taeniothrips gladioli* M. & S.) is primarily a pest of gladiolus, but the insect has also been found feeding on iris. Up to the present time there is no evidence that this thrips hibernates out of doors. It appears to pass the winter only on gladiolus corms kept in storage.

This being the case, the insects probably move over to iris during the growing season from infested gladiolus plants near-by. Gladiolus thrips are tiny insects with long narrow bodies. The young thrips are yellowish in color, while the adults are dark with long slender fringed wings. At the base of each wing there is a lighter area. When the wings are at rest and folded flat, these light areas appear as a distinct transverse stripe on the insect's back.

Control

A spray which has proved effective against this thrips on gladiolus is one composed of the following ingredients: 2½ level teaspoonfuls of arsenate of lead, 4 tablespoonfuls of molasses, and 1 gallon of water. On gladiolus it has been found that this spray kills more quickly when rotenone is added at the rate of 1 to 800.

The lesser bulb fly

In the late summer and fall it is not at all uncommon to find iris rhizomes infested with small whitish maggots about ¼ of an inch in length. These maggots are larvae of the lesser bulb fly (*Eumerus strigatus* Fall.). The adult of this insect is somewhat similar in appearance to the common housefly, though slightly smaller in size. Where an infestation occurs, an examination of the rhizome generally indicates that it had been previously injured by the iris borer and that a root rot had followed the work of the borer. The maggots cause no real injury to the plant, they simply feed on the already rotted rhizome.

Control

As just stated, the lesser bulb fly is not a true pest, so there is no particular object in trying to control it. Its presence in iris rhizomes can be prevented, however, by eliminating the conditions which make rhizomes attractive to the insect and thus prevent eggs from being laid. In other words, one can apply the control measures suggested for the iris borer (page 35) and for the root rot (page 30).

IRIS BREEDING

L. F. RANDOLPH[4]

THE NUMEROUS cultivated varieties and species of bearded iris provide abundant favorable material for the hybridizer interested in the production of new and improved types. Seed may be obtained readily from most garden sorts, either by pollinating the plants with their own pollen or by intercrossing them with related sorts. In common with most other groups of plants, unrelated species and varieties of iris cross less readily than do the more closely related species and varieties, and the resulting hybrids ordinarily are partly or completely sterile. However, valuable new varieties are sometimes obtained from crosses which are difficult to make. Sterile hybrid seedlings have potential garden value, for the bearded iris is propagated vegetatively by a division of the rhizomes or rootstocks, and the lack of fertility does not alter the attractiveness of the flower.

In common with most other plants that are propagated vegetatively, iris varieties do not breed true from seed, and intercrosses between varieties often are extremely variable. This is due in part to an inherent tendency to variation and in part to the complex hybrid nature of most iris varieties. This variability in iris has made possible the production of large numbers of distinct garden varieties during the past 100 years in which iris breeding has flourished. Since the problems of the iris hybridizer are best understood when considered from the standpoint of origins, the following discussion of iris breeding is presented from the historical viewpoint, with considerable attention given to the natural species from which modern horticultural varieties have been derived.

History

Bearded irises have been in cultivation for many centuries. In the famous Herbals of the Middle Ages many kinds were described and illustrated. As early as 1600 the extreme variability of irises grown from seed was emphasized by Carolus Clusius. In his *Rariorum Plantorum Historia*, published in that year, a description of some twenty-eight sorts was followed by this statement, "a long experience has taught me that irises grown from seed vary in a wonderful way." These observations of Clusius were confirmed by a contemporary, Francois Van Ravelingen, who published in a Dutch edition of the *Guydtboeck of Dodoens* (1608) a long

[4]Associate cytologist, Division of Cereal Crops and Diseases, of the Bureau of Plant Industry, of the United States Department of Agriculture and Research Associate, Department of Botany, New York State College of Agriculture, Ithaca, New York.

list of variations in the roots, leaves, stems, flowers, and seeds of iris, and stated that seedlings commonly were not identical with their parents.[5]

These statements concerning the variability of irises in cultivation more than 300 years ago are noteworthy in view of the modern theory that the majority of the tall bearded varieties commonly grown in Europe prior to 1900 were derived from various forms and hybrid combinations of *I. pallida* Lam. and *I. variegata* L., native European species of widespread distribution in south-central Europe. These two species are very dissimilar. *I. pallida* has a tall stem with short lateral branches, scarious spathes, and lavender self-colored flowers. *I. variegata* has a shorter more widely branched stem than *I. pallida*, has herbaceous spathes, and flowers with yellow standards and brownish purple veined falls. The hybrids of these species are chiefly intermediate forms with flowers mostly in clouded shades of bronze or reddish purple. Numerous color forms of both *I. pallida* and *I. variegata* are known from their natural habitats, and these, together with innumerable hybrid combinations, including the Amoena and Plicata types, are thought to have produced the majority of the older European varieties of tall bearded iris.

The dwarf bearded irises are genetically distinct from the tall bearded sorts. Little is definitely known concerning the early history of the numerous garden varieties of dwarfs, but it is probable that they originated chiefly from the native dwarf species, *I. chamaeiris* Bert. and *I. olbiensis* Hén. and their natural varieties, which are widely distributed in Central and Southern Europe. The horticultural forms commonly referred to as *I. pumila* are undoubtedly derivatives of these two species, and are not to be referred to the true *I. pumila* L., a central European species, which in most gardens rarely sets seed, and when crossed with *I. chamaeiris* gives a sterile hybrid. *I. subbiflora* Brot., native in Spain and Portugal, *I. imbricata*, Lindl. of the Caucasus, and *I. reichenbachii*. Heuff. of the Balkans are other dwarf species from which cultivated varieties have been developed. At the close of the last century Caparne, in England, and Millet, in France, produced garden varieties of dwarf bearded irises in considerable numbers, and from these many of the present-day varieties have been derived.

The growing of irises from seed with little regard to parentages or to regulated crossing was very popular in Europe during the early part of the nineteenth century. Records of varieties obtained in this manner were published by Von Berg (1833–1835) in Germany and by de Bure (1837, 1842) in France. About 1840 the famous French nurserymen, Lemon

[5]For a more detailed history of bearded irises refer to *The Development of the Tall Bearded Irises in the 19th Century*, by Ernest H. Krelage (American Iris Society Bul. 2, 1–14, 1921); also to papers presented by Krelage, Bliss, Yeld, R. S. Sturtevant, Mottet, and others, at The First International Conference on Iris held at Paris in 1922, and published under the title, *Les Iris Cultivés*, by the Societé National d'Horticulture de France, Paris, 1923.

FIGURE 24. GROWN BEFORE 1600, I. PALLIDA DALMATICA, NOW PRINCESS BEATRICE, IS STILL RATED AS ONE OF THE BEST OF THE LAVENDER-BLUE VARIETIES

and the Verdiers, began issuing extensive lists of named varieties, and during the next thirty years hundreds of named seedlings were offered to the trade in France. Jacquesiana and Madame Chereau are two outstanding varieties introduced by Lemon in 1840 and 1844, respectively. Salter and Parker were well-known nurserymen in England from 1850 to 1870, and Queen of May and Cordelia were introduced by them. In America, William Prince, proprietor of the Linnean Botanic Garden and Nurseries of Long Island, New York, published in his catalogs, beginning about 1820, lists of iris varieties and species of both American and European origin. Little information is available concerning the production of iris seedlings in America during this period.

The systematic breeding of iris began late in the nineteenth century with the pioneer work of Sir Michael Foster in England and Eugene Verdier in France. At about this time numerous collections of iris from many parts of the world were brought together, and these, along with the varieties then in cultivation, provided ample material for extensive crossing experi-

ments. The evidence obtained from the early crossing and inbreeding tests of Foster, and of his contemporaries, Bliss and Dykes, has been generally accepted as proof that the older European garden varieties originated from the two native European species, *I. pallida* Lam. and *I. variegata* L. From later evidence it has been firmly established that the highly sterile *I. germanica* L., also native in central Europe, is not a true species but a hybrid, derived possibly from *I. aphylla* L. as one parent. Few garden varieties owe their origin to *I. germanica*, according to the present generally accepted view. Thus the prevalent use of the designation "German irises" for the group under discussion is misleading and undesirable.

A renewed interest in iris breeding resulted from the general recognition early in the twentieth century of the horticultural value of the large-flowered Oriental species and varieties of tall bearded iris. The most important of these were *I. cypriana* Baker and Fos., *I.*

FIGURE 25. ALCAZAR

This iris has long been an outstanding blue bicolor. It was originated by Vilmorin (France) in 1910

FIGURE 26. FLAVESCENS, OR CANARI-BIRD, AN OLD STANDBY, IS GRADUALLY BEING REPLACED FROM THE WIDE SELECTION OF NEW YELLOW VARIETIES

trojana A. Kerner, *I. kashmeriana* Baker, and the partially sterile *I. macrantha* (Amas). Foster early recognized the value of these types as indicated by his use of *I. cypriana* in the production of Caterina, Lady Foster, Shelford Chieftain, Kashmir White, and Miss Willmott. Other European breeders of this same period also produced many important new varieties, which originated either solely from the Asiatic types or from crosses between the Asiatic and European types. As examples may be cited the varieties Alcazar, Ambassadeur, and Magnifica of Vilmorin, Souvenir de Madame Gaudichau of Millet, and Dominion of Bliss. While it is true that the parentage of some of these varieties is uncertain, the cytological evidence (see list of chromosome numbers, page 46) clearly indicates that at least one parent of each of these varieties was an Asiatic type.

The breeding of improved types of iris in America was initiated by Bertrand H. Farr, who began publishing lists of new varieties in 1909. His well-known introductions and those of other pioneer American iris breeders, such as William Mohr, Grace Sturtevant, and E. B. Williamson, originated in part from the older European sorts and in part from the newer Asiatic forms. In the origination of the more recent introductions both in America and in Europe, the Asiatic types and their derivatives have played a very important part, because these forms possess valuable new characteristics, such as an increased size and vigor, an improved style of branching, and, in combination with other sorts, a wide range of color variation.

Breeding behavior

A genetic analysis of breeding behavior in iris has been attempted by a number of hybridizers, and it is clear that certain characters at least have a relatively simple mode of inheritance, subject to a simple Mendelian interpretation. In a discussion of hybridization problems in iris, R. S. Sturtevant has reported that venation of the flower is dominant over self color, that bicolor also is dominant over self color, and that plicata and velvet texture are recessive.[6] However, many of the characters of importance in iris breeding, when brought together in hybrid combination, do not exhibit dominance or recessiveness but rather blending; that is, the hybrid is intermediate between the two parents. This is true with reference to height of stem, shape of flower, and to a large extent flower color. But, as Shull[7] pointed out long ago, there are two distinct classes of flower color, the anthocyanins, which are sap colors and comprise the blues, purples. and reds, and the yellow plastid colors. The purple and yellow colors undoubtedly are inherited independently of one another; but when both are present in the same flower, various rather distinctive blends are created.

The marked improvement in bearded irises from the time of Foster to the present day has been accomplished by careful selection and breeding. From a wide range of available forms the best types are selected as parents and from their progeny selections are again made for further improvement. It should be borne in mind by the amateur breeder that the vast majority of the seedlings of most garden varieties of iris are definitely inferior to the parent variety. Large numbers of individuals must be grown to provide a reasonable chance of obtaining desirable new types.

In iris breeding the question of fertility is of primary importance. Certain forms set seed readily, but many others are partly or completely sterile. Some varieties are fertile in certain combinations and not in others. It is, therefore, important that the prospective iris breeder should consider the question of fertility in planning hybridization studies. In recent years a notable advance has been made in analyzing the causes of sterility in plants. It is clear that certain cases are due to genetic factors for sterility, which may be studied with the same methods that are applied to the study of hereditary characters in general. Other types of sterility are due to relationships involving the chromosome bearers of the hereditary factors, which require analyses of chromosome number and behavior for their interpretation.[8]

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[6]Sturtevant, R. S. Hybridization. *In* Irises for the Beginner. American Iris Society Bul. 10:24–30. 1924.
[7]Shull, J. Marion. Color in the iris family. *In* Description of Varieties. Part I. American Iris Society Bul. 6:11–12. 1922.
[8]For reports on the fertility of cultivated irises refer to the following articles in Bulletins of the America Iris Society: *Notes from my Hybridization Records*, by Grace Sturtevant (Bul. 2, p. 29, 1921); *List of the Fertility of Iris Varieties*, by A. J. Bliss (Bul. 3, p. 28, 1921); various reports on iris breeding by Dr. A. B. Stout and his co-workers at the New York Botanical Garden, published in the Bulletin from 1925 to 1930; and *Twelve years of Iris Breeding in California, Methods and Records*, by Edward O. Essig (Bul. 52:3–30, 1934).

In recent years the chromosomes have been investigated in a large number of species and horticultural varieties of iris. From these studies much new information has been obtained which has been very helpful in interpreting the breeding behavior of garden irises. The number of chromosomes in a selected group of varieties and species, including both old and new sorts of dwarf, intermediate, and tall bearded irises, is given in the following tabulation.[9] The numbers given are the somatic numbers, that is, the numbers present in the body cells of the plant. By a process of reduction, which takes place as they are being formed, the germ cells normally possess one-half the number of chromosomes present in the body cells; and when the male and female germ cells unite to form a new individual the somatic or double number of chromosomes is again recovered. Thus a constant chromosome number is maintained by a given species from one generation to another.

Selected list of chromosome numbers in bearded iris

Aurea	24	Ma Mie	24
Candlelight	24	Mme. Chereau	24
Caprice	24	Mrs. H. Darwin	24
Chalice	24	Nebraska	25
Cordelia	24	Odoratissima	24
Flammenschwert	24	*pallida*	24
Flavescens	24	Pallida Dalmatica	24
Florentina	24	Prairie Gold	24
Gay Hussar	24	Princess Beatrice	24
Gold Imperial	24	Queen of May	24
Jacquesiana	24	Ruhyd	24
Liberia	26	*variegata*	24
Lodestar	25	White and Gold	24
Andromede	36	Isoline	36
Ansarben	36	King Tut	36
Aurea	36	Mlle. Schwartz	36
Ballerine	36	Queen Caterina	36
Coronation	36	San Gabriel	36
Imperial	36	Ticonderoga	36
chamaeiris	40	Pumila Caerulea	40
Cyanea	40	*reichenbachii*	40
mandshurica	40	Rupert	40
olbrunsis	40	*subbiflora*	40
albicans	44	Ingeborg	44
Cyrsero	45	Ivorine	44
Dauphin	44	*kochii*	44
Diamond	44	May Gold	44
Florentina	44	Odin	44
germanica	44	Soledad	44
Amas *macrantha*	48	Helios	48
Ambassadeur	50	Kashmir White	50
Argentina	50	L. A. Williamson	50
Autumn King	46	Los Angeles	49
Baldaeo	47	*mesopotamica*	48
Bea Sabreur	50	Miss Willmott	51
Candlelight	48	Moonlight	47
Cardinal	49	Morning Splendor	48
Caterina	48	Nëne	48
Conquistador	49	Purissima	47
cypriana	48	Red Robe	48
Desert Gold	50	Santa Barbara	46
Dominion	50	San Francisco	47
Dogwood	50	Shasta	48
El Capitan	48	Souvenir de Michaud	48
Esplendido	48	*trojana*	48
Fire God	48	Valor	48

[9]These chromosome numbers were obtained chiefly from the following sources: *Chromosomes in Iris Species* by A. E. Longley. Amer. Iris Soc. Bul. 29:43-59, 1928; *Le Nombre des Chromosomes chez les Iris* by Mme Simonet. Soc. Nat. d Hort. Bul. 2:88-94, 1929.; and *Chromosome Numbers in Native American and Introduced Species and Cultivated Varieties of Iris* by L. F. Randolph (Amer. Iris Soc. Bul. 52:61-66, 1934).

The European *I. pallida* and *I. variegata* and their derivatives, which constitute the majority of the tall bearded varieties introduced prior to 1900, are diploids with twenty-four, or approximately twenty-four, somatic chromosomes. The Asiatic *I. cypriana*, *I. mesopotamica*, *I. macrantha* and *I. trojana* are tetraploids with forty-eight chromosomes, and their derivatives, which comprise the vast majority of the modern horticultural varieties of tall bearded iris are also tetraploid or pseudo-tetraploid forms. Hybrids between the older European diploids and the modern tetraploids would be expected to be triploid, and a limited number of varieties with thirty-six chromosomes do occur. *I. chamaeiris*, *I. olbiensis* and other dwarfs have forty chromosomes. A notable exception is the true *I. pumila* with thirty-two chromosomes, and the dwarf variety Azurea which has thirty-six chromosomes.[10] The well-known hybrids obtained by intercrossing the dwarf and tall bearded sorts are intermediate, not only in height and in blooming period, but also in chromosome number. The native European *I. germanica* L. and *I. kochii* Kerner, and the Arabian *I. albicans* Lange, also have forty-four chromosomes, which strongly suggests a similar hybrid relationship for these species.

Iris breeders repeatedly have experienced difficulty in crossing the diploid *pallida* and *variegata* types with the large-flowered tetraploid Asiatic and Oriental types. The difference in chromosome number explains this difficulty. Furthermore, the triploid hybrids obtained from such crosses apparently have not proved to be favorable material for breeding purposes, owing to a pronounced infertility in most cases and a tendency to produce offspring lacking in vigor. A similar situation prevails among the hybrids between the dwarf and the tall bearded varieties, which also have different chromosome numbers. This is the type of breeding behavior ordinarily displayed by varieties or species with unlike chromosome numbers.

It has often been said that the marked improvement in the garden varieties of tall bearded iris in the last few decades has been accomplished chiefly by hybridizing the older, small-flowered, European varieties with the newer, large-flowered, Asiatic sorts. As evidence of this, attention is directed to the fact that a considerable number of the important large-flowered varieties, such as Dominion, Ambassadeur, Grace Sturtevant, Lent A. Williamson, Reverie, and others, exhibit unmistakable signs of *variegata* parentage. For example, in these varieties the pure blue, lavender, and purple shades of the original Asiatic types are displaced by varying shades of brownish purple with traces of yellow; and it is just such blends of yellow and purple that previously were obtained repeatedly by inter-

[10] The chromosome studies of Simonet (*Recherches cytologique et genetique chez les Iris*, Bul. Biol. France et Belgique 66:245–444. 1932.) indicate that Azurea is a hybrid between *I. pumila* and a 40-chromosome dwarf type. All of the other garden varieties of dwarf bearded irises which have been examined cytologically possess 40 chromosomes and presumably have been derived from 40-chromosome sorts rather than from *I. pumila*.

crossing the *variegata* and *pallida* types, the latter with respect to flower color being very similar to the Asiatic sorts. But the chromosome studies have shown that these large-flowered varieties with *variegata* characteristics are tetraploids like the Asiatic sorts, and are not triploids as would be expected if they represent ordinary first-generation hybrids between the diploid European and tetraploid Asiatic types.

A number of possible explanations may be offered to account for this very interesting situation. These *variegata*-like characteristics may have been present in the germ plasm of the original Asiatic species where they remained undisclosed until brought to expression in subsequent generations either of inbreeding or crossbreeding the Asiatic types, without admixture with the European sorts. Or, the tetraploid-*variegata* sorts may have been obtained from triploid hybrids between European and Asiatic sorts through subsequent backcrossing with the Asiatic tetraploids. Another possibility is that tetraploid rather than triploid first-generation hybrids may have resulted from crosses in which the European diploid was the seed parent and the Asiatic tetraploid was the pollen parent. For this to have happened it is necessary to assume that an unreduced egg cell with twenty-four chromosomes, rather than a normally reduced egg with twelve chromosomes, functioned in combination with a normal twenty-four-chromosome male gamete from the pollen parent. This explanation was offered recently by Simonet to account for the origin of the tetraploid variety Ambassadeur from the diploid variety Liberia and the pentaploid Magnifica from the triploid Isoline.[11] Still another possibility is that the yellow color present in the *variegata*-like tetraploids may have been derived from certain yellow dwarf varieties. By backcrossing a forty-four-chromosome first-generation hybrid between a forty-chromosome dwarf and a forty-eight-chromosome tall variety to the forty-eight-chromosome parent sort it would be readily possible to obtain tetraploid varieties with an admixture of yellow color. It remains for future study to determine to what extent any one or possibly all of these suggested interpretations may correctly explain the origin of the extreme diversity of form and color exhibited by the modern improved varieties of tetraploid tall bearded iris.

The rapid advance in the improvement of garden varieties of tall bearded irises during the past thirty or forty years has resulted almost exclusively from intercrossing the Asiatic tetraploids, *cypriana*, *trojana*, *mesopotamica*, *macrantha* (Amas) and their derivatives, and less frequent crossing with the older European sorts. From large numbers of seedling progenies in successive generations the best types have been carefully selected for further improvement. Much of the difficulty experienced by iris breeders in interpreting breeding behavior on a genetic basis probably

[11]Simonet, M. *Recherches cytologique et genetique chez les Iris* Bul. Biol. France et Belgique 66:416. 1932.

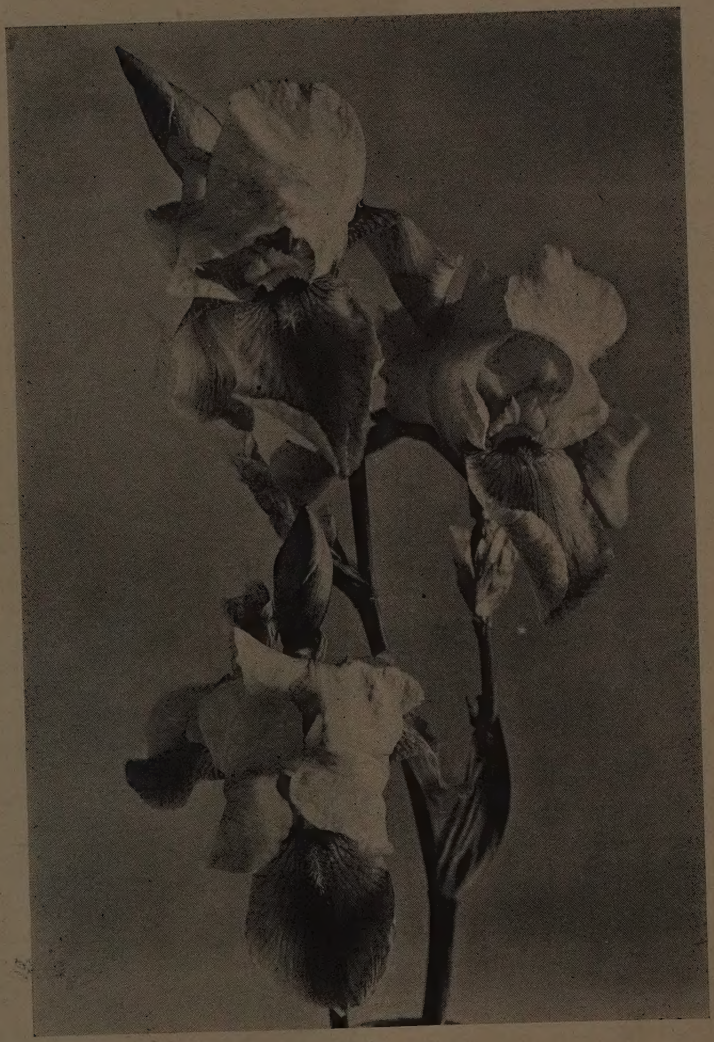

FIGURE 27. AMAS

This is a near relative to the modern variety Dominion

has been due to the fact that they are dealing with tetraploids rather than with diploids. The frequency with which segregation and recombination of individual characters takes place differs very greatly in diploids and tetraploids, and this fact must be considered in any attempt to analyze the hereditary behavior of characters in iris.

Many new vareties of iris are being produced yearly by amateur and professional breeders throughout the country. High standards of excellence have been attained, but there is still abundant opportunity for further improvement. The bearded iris offers a wealth of favorable material for crossing experiments, for both the amateur and the professional breeder.

Controlled pollinations

The technique of hybridizing irises is relatively simple, and controlled pollinations are easily made because of the large size of the flower and the ease with which foreign pollen can be excluded. The essential structures which function in pollination are the stigma, which receives the pollen, and the anthers in which the pollen is borne. These and other parts of a bearded iris flower are illustrated in figure 5.

In making controlled pollinations, the anthers of the flower to be pollinated are removed before the bloom unfolds. This may be done very readily with a small pair of forceps. In order to exclude the possibility of contamination by insects, the emasculated flower is protected with

FIGURE 28. MM. CHEREAU

This plant, raised by Lemon of France in 1844, is one of the oldest varieties of the modern group of tall-bearded iris. It is still a popular variety

a light-colored cloth or paper bag. White bags absorb less heat than do dark ones, and this is of some importance in obtaining a good set of seed. As soon as the flower is fully expanded and the upper receptive surface of the stigma is reflexed the flower is ready to be pollinated. In making a pollination, the protecting bag is momentarily removed, a discharging anther is brushed over the stigma, and the bag is again replaced. Each of the three stigmas of the flower must be pollinated to obtain a full set of seed. Mid-forenoon of a sunny day is the ideal time to make crosses.

As soon as the styles have withered, the bag should be removed, the spathes which hold moisture and cause rot should be stripped off, and a permanent record of the cross should be made. A satisfactory way to do this is to attach a tag to the flower stalk with a short string at the time the cross is made. When the pods begin to turn brown and split open at the tip, the seed should be harvested.

Growing iris from seed

The ripened seed may be planted immediately after it is harvested or later in the fall. Layering in flats or in a specially prepared seedbed are both satisfactory. It is essential that the seeds be covered at least one-half inch deep. Protection from washing or other disturbing factors is insured by pegging ordinary wire screen over the area. A loose covering during the winter is beneficial, if applied after freezing and removed in the spring before growth starts.

When the seedlings are an inch or more in height, they should be planted in specially prepared beds. These are made in advance, so that lime and superphosphate may be incorporated and excellent drainage assured. Seedlings may be planted 1 foot apart in rows 3 feet apart, and should remain there until they have reached maturity and their future has been decided. Weeding is all they require, though good culture will ensure bloom for most of them in two years. Since all the seed does not germinate the first year, it is necessary to maintain the original seed area for a longer period. Seeds frequently germinate after a delay of several years.

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